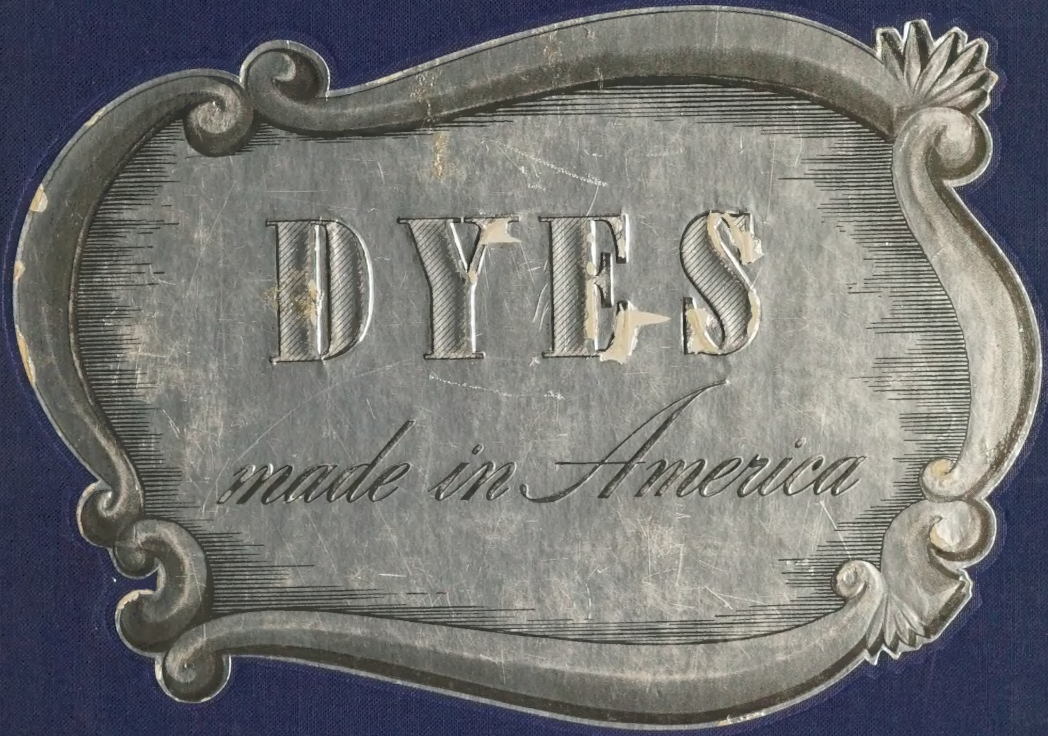
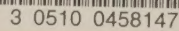
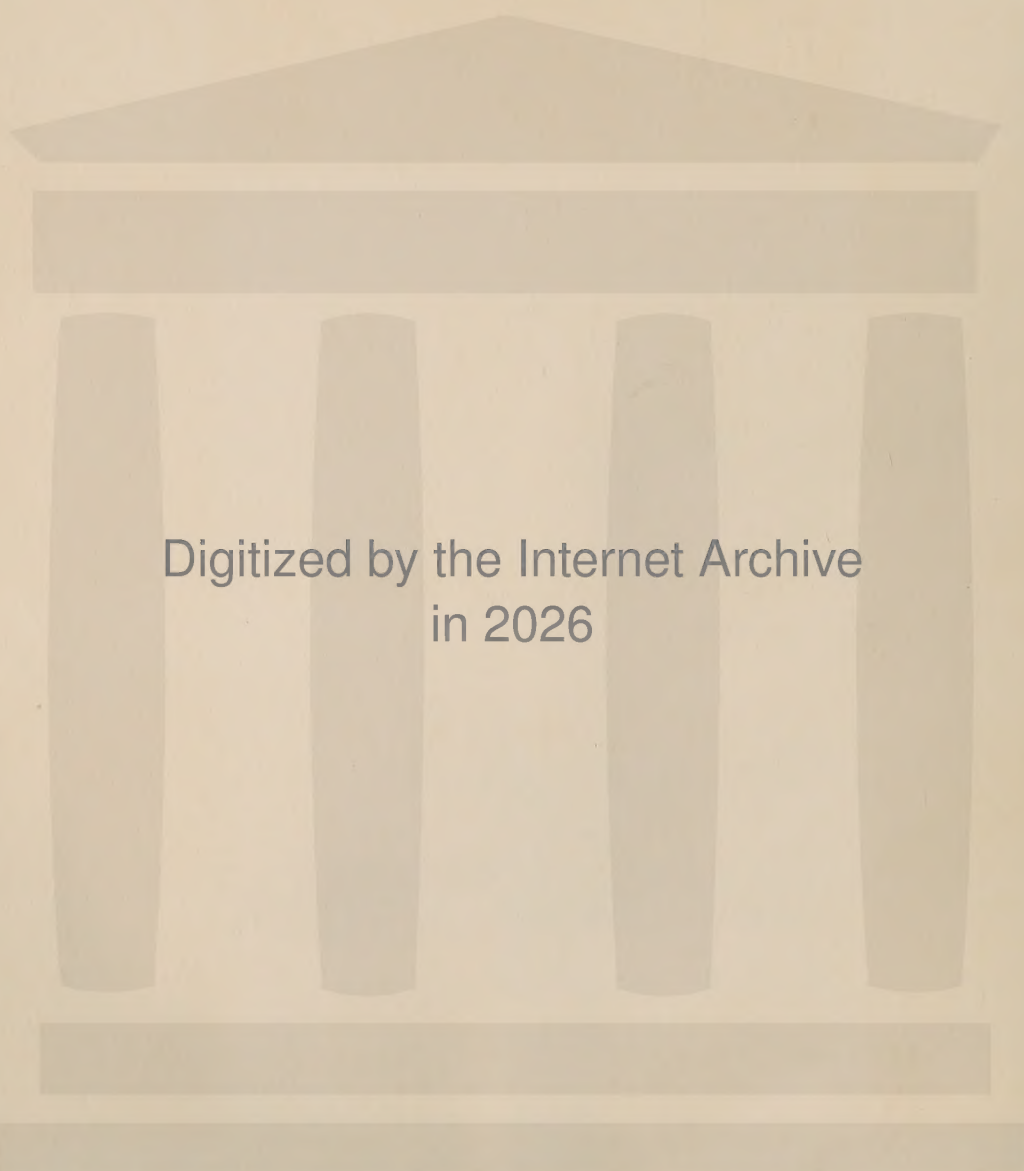




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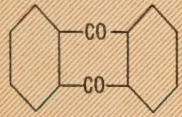
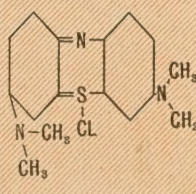


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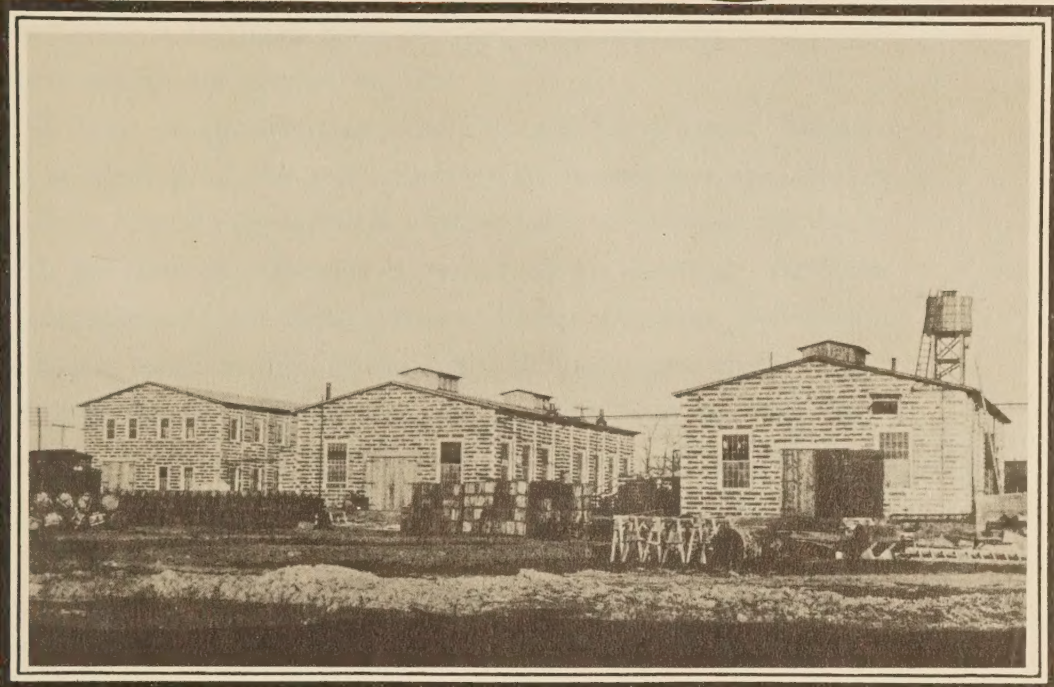
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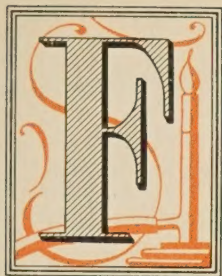


	<chem>Nc1ccccc1</chem>		<chem>CN(C)c1ccccc1</chem>	
<chem>Clc1ccccc1</chem>	DYES <i>made in America</i> 1915  1940 Williams Haynes CALCO CHEMICAL DIVISION AMERICAN CYANAMID COMPANY BOUND BROOK, NEW JERSEY			<chem>Oc1ccccc1</chem>
				
				
<chem>N=Nc1ccc(S(=O)(=O)O)cc1</chem>				
<chem>SO3Na</chem>				





CALCO PLANT
1915



FAMINE threatened this country in 1915. Not, to be sure, a dearth of food, but a dangerous shortage of many essential chemicals—fertilizers, dyes, medicinals—threatened to cut down our crops, to close many mines and mills, to cripple the work of our hospitals and physicians. We were awakened with a shock to the terrifying fact that despite our isolation, despite all our resources, we could be neither safe, nor prosperous, nor even healthy if the United States remained dependent upon foreign countries for certain vital chemical supplies.

In 1940—twenty-five years later—we again face a general European war in which blockades and embargoes are favored weapons, through which the historic rights of neutral nations are utterly disregarded, and by which the customary channels of world trade are disrupted. But today we are imperiled by no chemical famine. In fact, unless one lived through the hectic, hazardous days of 1915, it is hard to conjure up the worries and fears, the make-shift processes and financial losses that were thrust upon us.

In the autumn of 1915 seven leaders of our textile industry sat down in anxious conference with Secretary of Commerce Redfield, begging him to use all the influence of the United States to induce Germany to raise the ban on dyestuff exports and then persuade Britain to permit these colors to pass through the blockade in order that they not be forced to close their mills. Back on August fifteenth the first American mill—a big blanket factory at Mystic, Connecticut—had actually shut its doors because its “drug room,” as the chemical warehouse was then still called, had been stripped bare of colors. Others had followed suit. All feared the same fate. Over 400,000 American textile workers might be thrown out of work.

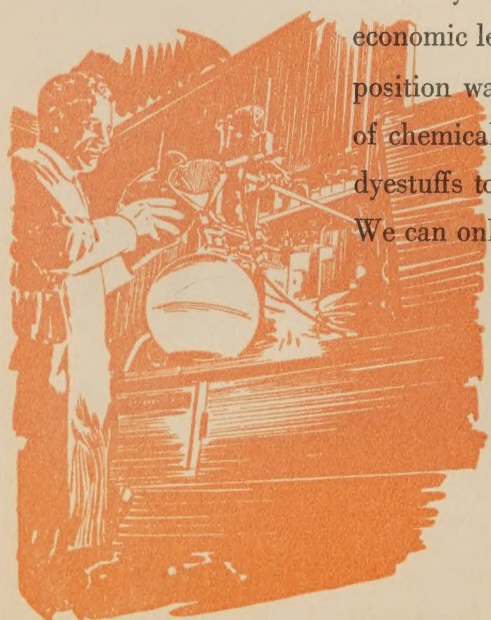
Salvarsan, the specific against syphilis, was being doled out to doctors at \$90.00 a pound. As staple and simple a coal-tar derivative as salicylic

acid had advanced from 22 cents to \$2.00. A year later it was to sell for twice this tidy sum.

Coal-tar intermediates, too, had soared in price: beta naphthol from 8 cents to 75 cents; aniline oil from 10 cents to \$1.35; paranitraniline from 17 cents to \$1.50. Fantastic as these prices now seem we must not forget that the crudes from which these products had to be prepared had also sky-rocketed. Toluol was selling at \$5.00 a gallon, against 35 cents pre-war; benzol at 70 cents against 30 cents; naphthalene at 18 cents against 2½ cents.

In the early stages of the World War supplies of coal-tar dyes and chemicals were not plentiful but adequate. Germany was anxious to export and shipments came through irregularly. But as the vital importance of chemicals became more apparent, the British contraband list grew longer and their blockade tightened. It became increasingly difficult to get chemicals through neutral sources, so two American agents for the big foreign chemical firms chartered an American vessel, S.S. "Matanzas," and imported from Rotterdam a cargo of dyes and medicinals. That shipload was reported to have been sold for over a million dollars. It was landed at New York early in the winter of 1914-15 and was the last big shipment of the sort received.

During 1915 these essential chemicals became important pieces in the three-cornered chess game of diplomacy between Washington, Berlin, and London. As a counter to the pressure of the British blockade of food-stuffs Germany embargoed all potash fertilizer salts, and she used dyes as an economic lever to pry loose American cotton which she sorely needed. Her position was clearly set forth by the president of the German association of chemical manufacturers when he wrote: "We are gladly ready to send dyestuffs to America, but we cannot accept this as a favor from England. We can only send dyestuffs when England recognizes the right of America



to receive our goods and you to send us cotton in exchange for dyes.”

There the matter stood. By the summer of 1915 chemical exports from Germany virtually ceased and the lack (notably of potash and cyanide, coal-tar dyes and medicinals) became a famine.

Among the thousands of American manufacturing firms struggling to keep their plants running with vanishing raw materials was the Cott-a-lap Company of Somerville, New Jersey, makers of high grade wall-covering fabrics. Due to the dislocation of shipping from India, jute, their basic fibre, was hard to obtain; but it was practically impossible to get dyes or beta naphthol which they used as a mold-preventative in the sizing for their wall burlaps. The company, which had started in New Haven in 1900 and moved to Somerville in 1909, enjoyed a growing business built upon quality, so that substitutes or makeshifts did not at all appeal to the management. That management was vigorous, resourceful, and courageous; and it determined, if dyes could not be bought, they would have to be made.

To launch forth into the manufacture of coal-tar chemicals was a momentous decision. Out of it grew an entirely new company which has in the past twenty-five years become one of the great units of our war-born chemical industry. It was a decision that, during the years to come, was to make heavy demands upon all the vigor, all the ingenuity, all the courage, that management could muster.

When they embarked upon this bold venture in chemical manufacturing, they knew nothing about how coal-tar dyes or intermediates were made. Save for their dyeing operations and the simple preparation of wall-paper paste, they had no experience with chemical apparatus or chemical processes. But they did have a good laboratory and a good chemist.

They supplemented him with an assistant and a couple of men who knew more or less about chemical making, and they called upon a professor of organic chemistry at Yale for consulting advice. With sets of Schultz's

HREE thousand years ago, the Hindoo craftsman learned to spin into a thread the white, fluffy fibres packed in the seed pod of the wild cotton plant of the foothills of the Himalaya Mountains. It is still true today that Cotton's versatility, strength, and ease of dyeing are its most distinguished properties. From sturdy denims to gossamer muslins, from luxurious drapery fabrics to smart broadcloths, cotton's flexibility makes it an ideal fibre for many different uses. No other fabrics have so unlimited a range of fast colors and none lend themselves so easily either to dyeing or printing. To the modern dyers and printers of cotton fabrics Calco offers a full line of direct (Calcomines), basic (Calcozines), sulfur (Calcogenes), and vat (Calcosol and Calcoloid) dyes.

In addition Calco offers Diazotized and Azoic dyes for cottons.



Farbstofftabellen and Friedländer's *Fortschritte der Teerfarbenfabrikation* and a well-worn copy of Bucherer's textbook of dyestuff chemistry, they set to work the hard way, turning theoretical book learning into practical plant operations.

Starting from scratch and taking chances with processes about which they knew so little had one great advantage. It did consume hours of unnecessary work; it did waste many a needed dollar; such fruitless experiments were also savagely discouraging; but they learned organic chemical synthesis from the ground up.

They were forced to work out for themselves the little technical tricks of the trade: the correct temperatures and pressures, just the best time cycle, the most efficient apparatus hook-up; and they had to devise their own methods of analysis.

With an eye fixed clearly upon their own dye needs, their starting point was plainly indicated—aniline.

This important intermediate, initial raw material for more than half of the five hundred most commonly used dyes, was scarce and high priced. If, as they hoped, they could produce more than their own requirements, here was a product that would assuredly find a ready market. In fact, a friendly, neighboring rubber manufacturer, who was in need of aniline for use as an accelerator, promised to take any surplus, if—and that was then a big “if”—it was of an acceptable quality and price was no stumbling block.

Prompted by similar good reasons, the Cott-a-lap management, which was certainly ambitious and optimistic, determined at the same time to undertake the manufacture of another intermediate, beta naphthol.

From this twin still tower Calco recovers light oils from coke oven crudes. These are refined into benzene, toluene and xylene that are the starting points for a series of fundamental intermediates which are used not only for dyestuff manufacture but also for rubber antioxidants and accelerators, explosives and pharmaceuticals. Through this operation, Calco exerts a close control over its basic raw materials.



Accordingly a crude little wooden building, a sort of glorified shed, was hastily built on a corner of the company's property at Somerville, and while awaiting the delivery of equipment, the legal organization of the Calco Chemical Company was completed. The new corporation was a wholly owned subsidiary of the Cott-a-lap Company. The name "Calco" was borrowed from the trade name of the highest grade burlap wall coverings made by the parent firm.

The aniline plant was first completed, and after three weeks of exciting test operations produced a good product. Right on its heels came Calco's "beta" plant, and again after some thrilling trials, it, too, was brought into commercial production.

This was early in the winter of 1915. Operations in the little plant began to smooth out, and vigorous research was feverishly conducted to add new products—aniline hydrochloride, dimethyl-aniline, R and G salts: simple preparations close to the intermediates now available. However, each new product involved a lot of hard study and a deal of juggling of apparatus. The new chemical enterprise seemed fairly launched when the City Fathers of Somerville put their foot down on any expansions of such a hazardous and odoriferous industry in their midst. Permission to erect additional buildings within the municipal limits was politely, but definitely, refused.

This official ban had two important effects. Calco reorganized and moved to Bound Brook.

Not all of the owners of the Cott-a-lap Company were enthusiastic over this chemical venture. Plenty of good reasons besides explosions and smells could be brought forward against it. Not the least was that it was obviously going to call for a very considerable investment which might be quickly lost if the war ended and foreign makers again assumed control over our coal-tar chemical markets.

Nobody who considered entering the dye industry could overlook the distinct possibility of an early German victory nor disregard the plain warning of the ruthless competition by which the foreign dye trust had choked the development of any coal-tar chemical industry in this country. Against these assaults the duty on dyes in effect at that time had proved utterly ineffective. Practically all dyes made in America before the World War were prepared from imported intermediates. Accordingly, the twenty per cent *ad valorem* duty on these raw materials merely resulted in whittling down the thirty per cent duty on the finished dyes to a net ten per cent.

Moreover, our patent laws played into the hands of the foreign dye manufacturers. With unique liberality we grant patent protection not only to a new process, but also to a new product, and we do not require the working of a patent in the United States in order to maintain its validity. Accordingly, a product patent covering this new material gave the patentee the sole right to produce it for seventeen years. Abroad, where only the process of making a new synthetic is patentable, the perfection of a second process enables another manufacturer to make the new chemical. By taking out product patents on well-selected key products, foreign manufacturers, without the least compulsion to manufacture in the United States, were able to block the development of a complete, rounded coal-tar chemical industry in this country.

The foreign dye companies were admirably organized to get all the commercial advantages accruing within this legal framework. Through the famous Dye Cartel they pooled their resources and eliminated competition. This Cartel did not hesitate to use its full powers vigorously, and it cherished no scruples against taking every advantage of our tariff and patent laws. Indigo, which was admitted into this country free and of which there was no American production, sold higher here than in Europe. Direct black, on the other hand, paid a duty of thirty per cent and was in compe-





FROM eight million pounds in 1920 to over five hundred million pounds in 1940, measures the amazing growth in our use of chemically-produced fibres. Rayon filaments are versatile—tough like a fishline or finer than the finest spiderweb—glossy or dull—in an endless, continuous length or chopped up into short staple fibres, possessing a great number of different specific chemical and physical properties, and possessed of distinct dye affinities. They have brought to the Textile Industry great opportunities in the manufacture of new cloths and to the colorist new possibilities and new problems.



tition with the largest American dye maker of that time, so it was priced at 22 cents a pound in Europe and 17 cents a pound in America.

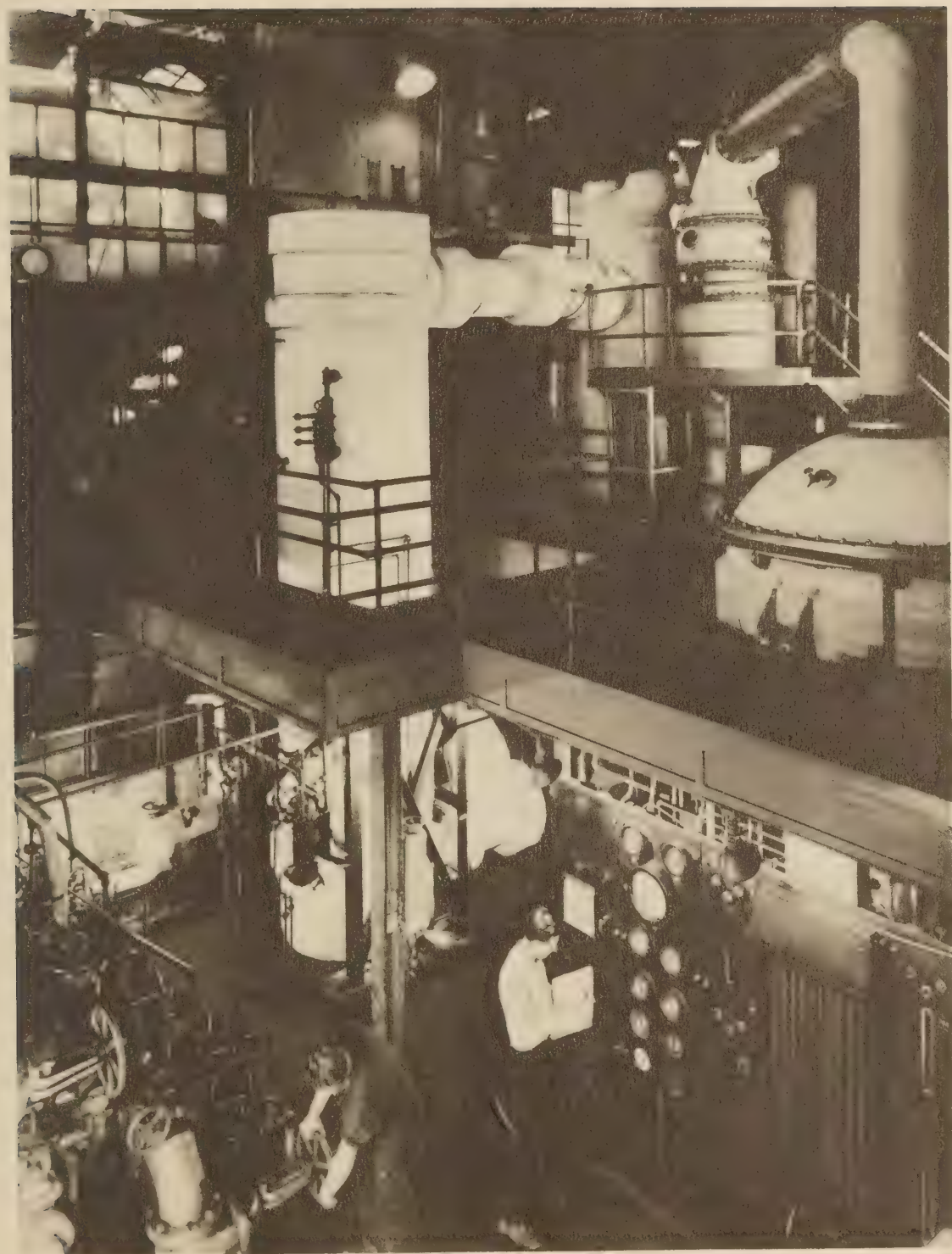
In other words, if there were no domestic competition, the American dye user was forced to pay a handsome premium. When there was effective American competition, however, the foreigners were quite ready to absorb the duty and cut the price.

To recoup the losses of such ruthless tactics they found their product patents, notably on medicinals, exceedingly useful. Acetylsalicylic acid, trade marked as "Aspirin," was sold here at 35 cents an ounce, while the price in Europe was 40 cents a pound. With such handsome extra profits on a number of well-chosen specialties, the Dye Cartel was amply fortified for a long and savage price war.

By these tactics they had reduced the coal-tar chemical industry in this country to seven companies. Only two of these produced more than twenty different colors. All of them added together had less than a tenth of the financial resources, the technical staffs, the number of products of the smallest of the six companies in the Cartel.

Forced to move their dye-making venture out of the city limits of Somerville, the Directors of the Cott-a-lap Company had to reckon realistically with a situation full of unknown factors. They knew that they must buy a site and build a new plant, and they could figure the costs of this initial investment pretty accurately. So long as the war lasted they would be safe from any serious competition from overseas. A demand at high prices for all sorts of coal-tar products would absorb at a good profit any output greater than their own dire necessities. But they could only guess at many facts and figures.

Nitric acid is one of the fundamental mineral acids that Calco makes for its own use. This modern plant efficiently produces large quantities of nitric acid from ammonia. Welded stainless steel and high pressure construction are characteristic of this structure. The perfection of the ammonia oxidation process by the chemical industry has made the United States independent of foreign raw materials for producing nitric acid.

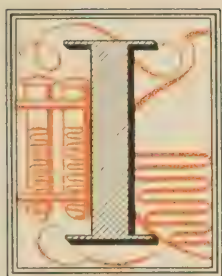


Once the new plant was in operation they could not figure what additional investments for research or equipment they would be called upon to make. Future supplies of raw materials—quantities available, delivery dates, even prices, were a series of unanswerable question marks.

How long would the war last? This was the greatest puzzle of all, and much depended on it. Obviously the abnormal demand would collapse like a toy balloon stuck with a pin. The high prices it created would be as suddenly deflated. Competition would be more severe than ever before. Adequate protection against dumping would have to go much farther than any *ad valorem* duties; and unless this was provided, the wiping out of any dye-making enterprise in this country was a foregone conclusion. For two years, pleas for such protection for an industry vital to defense and to prosperity had been made to Congress. However, President Wilson and the majority in both the Senate and House had been elected on a platform of “tariff for revenue only,” and the chances of reversing the Democrats’ traditional tariff position certainly did not appear to be bright.

Striving to arrive at what reasonably seemed to be the most likely probabilities, the Directors weighed all these possibilities. They had few tangible figures and no reliable market data. Even precise prices were unknown. The Board divided and those who favored going ahead with the dye-making project compromised by deciding to back the risky venture personally and independently.





IN THE spring of 1915 a farm of eighteen acres was bought at Bridgewater, New Jersey, adjoining Bound Brook. The land lay between the Central of New Jersey and the Lehigh Valley Railroads and was flanked on one side by a little stream, a tributary of the Raritan River—

a fine combination of facilities for an embryo dyestuffs plant. Ground was broken immediately and by fall three stout, little buildings had been built.

Number One, measuring forty-two by seventy-eight feet, was the only two-story structure, the second floor being used for the office, library-conference room, dormitory, kitchen and dining room, while the ground floor was laboratory and warehouse for raw materials and finished goods. Numbers Two and Three, each forty-two by eighty-two feet and a story and a half high, were respectively the beta naphthol and aniline plants.

Within the year both these plants had to be rebuilt, larger and better equipped. A new nitration building was added; and since these expanding operations demanded greater services, a new water supply was tapped, a boiler plant and a machine shop were erected, and a refrigeration plant started. In December, 1916, a new office building was also completed and opened with a little jollification that gave expression to the loyalty and pride of accomplishment that inspired that little group of hard-working men who were literally creating a new industry in America.

The new administrative headquarters were quite pretentious—three stories tall, forty by a hundred and four feet—and here at last, so all agreed, was a structure that would never be outgrown! The two lower floors housed the general offices, the research, operating, and engineering executives; the sales, accounting, purchasing, and traffic departments; all the clerical staff; and the drafting room which it is interesting to note occupies today more floor space than the entire two stories of that 1916 administration building. The third floor was still used as a dormitory, kitchen, and

dining room. In those days, the staff literally lived on the job, working day and night.

As the Calco plant grew, its products multiplied. By the end of 1916 to beta naphthol and aniline had been added aniline hydrochloride, R and G salts, and dimethyl-aniline. The first of the Calco dyes had also been produced: methylene blue, crimson, scarlet, and tartrazine.

Piece by piece the Calco research chemists were fitting together the jigsaw puzzles of coal-tar synthesis. Bit by bit the operating staff was carrying them over to commercial scale production. Each new intermediate and every new dye made the picture clearer.

Those were feverish days of hard work, bitter disappointments, and fine triumphs. And out of that experience came lessons that the Calco management learned to appreciate as the only sound basis for successful dyestuff manufacture.

Having discovered, for example, that the available technical literature did not tell the complete story of coal-tar technique, the Calco research men soon found out that neither was orthodox practice the last word in efficient and economical manufacture. Thus, according to the textbooks, the sulfonation of naphthalene should require eighteen hours; by conjuring with pressures and temperatures these men were able to complete the reaction in seven hours. After several months' experience they learned how to produce a pure, water-white aniline which one customer, who had been accustomed to the claret-colored imported material, telegraphed them was not aniline at all.

Such experiences served to drive home the fact that even in the simplest processes and most highly standardized products there always lies the opportunity of finding a better way or of producing a purer material. Thus Calco learned the first imperative lesson of dye-making: the necessity for research, more research, better research.

They learned, too, the vital importance of standardized raw materials. One of their earliest products was dimethyl-aniline, prepared from methanol which in those days they brought to Bound Brook in their own truck from the big wood chemical refinery at Buffalo, New York. This was years before synthetic methanol had appeared on the market and the natural material, distilled from hardwood, almost invariably—in those hectic days of forced production to meet war demands, “almost inevitably”—contained more or less acetone. However, the slightest trace of acetone produced a methane base which upset some reactions and cut down yields. It took several days to ferret out the chemical cause of this operating difficulty, and the sole solution lay in the scrupulous removal of all acetone from their raw material: another research and another step added to the operation.

These troubles were trivial compared to the complications that arose from the uncertain quality of the benzene then available. This essential coal-tar crude could not then be purchased with a boiling point guaranteed within 20° , and it was sure to be contaminated with paraffins and unknown amounts of various sulfur compounds. More kinks in operation to iron out; more intensive studies of chemical causes and effects; new methods of purification to be devised; but another invaluable lesson was learned.

Start with the basic raw materials and scrupulously purify them. Out of these standardized crudes produce thoroughly dependable, low-cost intermediates. Then, and only then, is a dye manufacturer working upon a solid foundation. Only upon such a broad chemical basis as this is it possible to produce colors of the highest quality that can be sold at reasonable prices.

Out of these experiences have crystalized the two chief tenets of Calco policy. Ceaseless research, research not only to improve quality and lower costs, but also research to check the practical value of Calco products in work-a-day use, to supply new color needs, to assist Calco customers in



their own application problems. Control of all Calco materials from the basic crudes, through the intermediates to the finished products, so that quality may be assured and the greatest possible economies achieved.

As these policies began to take definite shape, a program for the future development of the Company evolved. The first tangible expression of this was a carefully drawn plan for plant and product expansion.

Under the pressure of the famine demand for coal-tar intermediates and dyes, new buildings sprang up at Bound Brook like mushrooms in a meadow after an August rain. Everyone was working against time, twenty-four hours a day, seven days a week; slaving to produce more goods; driving ahead in order to get as great a start as possible before the war ended and the Germans came back into the field. When operations outgrew one building, another was thrown up alongside.

However, confidence born of success, in the face of great difficulties, inspired the management with a firm belief that they were building a real business, a new industry that would live in America. Accordingly, they began to plan for the future. A complete research program was laid out, which concentrated first upon intermediates, and second, upon dyes that might be made from the intermediates which Calco was already producing. A standard type of manufacturing building was designed and a general plant layout was planned so that Calco ceased to "just grow like Topsy" and began to develop into a fully rounded and completely integrated coal-tar chemical manufactory.

Another starting point for making dyestuffs is crude coal tar. In these towers chemicals are distilled from the coal tars; chemicals that form the basis for many of our most important dyes. These chemicals, naphthalene, phenols and anthracene, in turn are converted into fundamental intermediates — beta naphthol, anthraquinone and a host of related derivatives.

An important first step in line with this program was the purchase of the Neidich Process Company of Burlington, New Jersey. Like the Cott-a-lap Company, this firm, manufacturers of carbon papers and typewriter





FROM earliest time, the hair of animals has been used for clothing man. Down to the present, little basic change has been made in the conversion of wool for this purpose. Today, however, with the addition of synthetic fibres to the wool, new problems have arisen; not alone for the spinner and weaver but for the dyer and the dye-maker. Calco's technical assistance has supported the colorist in solving the new problems thus created.

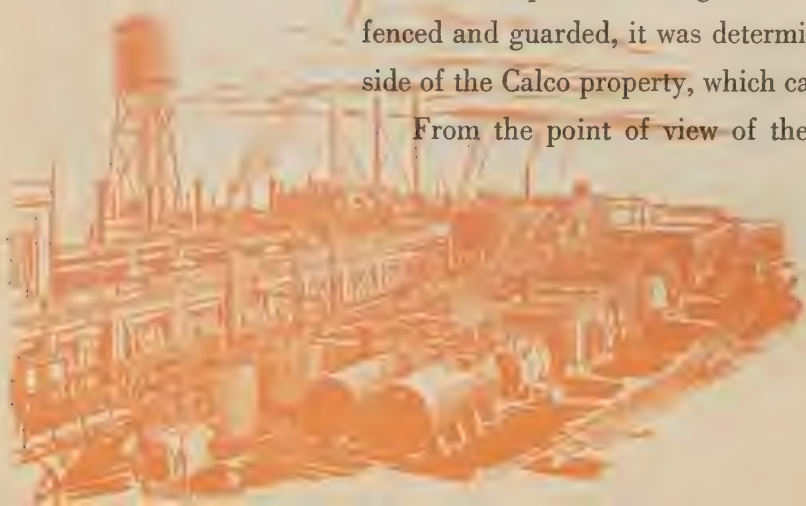


ribbons, had been tempted to end its own color starvation by undertaking to manufacture its own methylene blue and methyl violet, only to discover that dye manufacturing was a more serious enterprise than it was expedient for them to carry forward. By this purchase Calco obtained a number of working processes for dyes and for salicylic acid, as well as little plants in Burlington and Jersey City.

The following year, 1917, saw two big new developments both arising out of the United States' entrance into the World War. For the army uniforms, chrome dyes were needed and Calco produced a full line of orange, brown, yellow and green colors of this type. The Ordnance Department was anxious to secure regular supplies of tetranitro-aniline, a powerful explosive, until then never produced in any land in munitions quantities, and turned naturally to the country's largest producer of aniline. As a patriotic duty Calco was asked to work out a practical, large-scale manufacturing process and to plan, build, and equip the plant necessary for a daily production of 7,500 pounds of T. N. A.

The project called for fourteen buildings, several of them of special construction, and a large power plant, as well as plants for the daily production of ten tons of nitric acid and forty tons of sulfuric acid, and for a pumping station on the Raritan River with a pipeline approximately 1,400 feet long to the plant. It also involved facilities for housing and feeding a large engineering and operating staff as well as two big bunk houses for common labor. It further required the purchase of a hundred-and-forty-acre farm at Millstone where the final drying operations could be carried on and the finished explosive stored without hazard to the community. As the Ordnance Department's regulations required that this explosives plant be fenced and guarded, it was determined to segregate this entire unit at one side of the Calco property, which came to be known as the "West Works."

From the point of view of the Ordnance Department T. N. A. pos-



sessed one great, obvious advantage. Its production required neither toluol nor caustic soda. The demands of the Allied armies for T. N. T. and picric acid put a heavy strain upon supplies of these chemicals. Therefore, anything that would conserve these stocks was more than welcome. From the point of view of the prospective maker, however, T. N. A. possessed a number of distinct disadvantages. To produce it in quantity required the correlation of several, big, tough jobs in record time.

Shoving aside their own research program, the Calco technical staff studied every step of the proposed operation in detail, and for each they built pilot plant tools to test the actual working conditions of the reactions. A long series of careful investigations upon the final nitration process resulted in a novel set-up of controls that greatly cut down the explosion risks of this exceedingly dangerous operation. All this was good experience won in a truly patriotic cause, but it did sidetrack the Company's own research at a time when, a firm foundation having been laid down, development was ripe.

While the chemists worked early and late on the reactions, the engineering staff planned the buildings and assembled the apparatus. Twenty-four hours a day a great construction crew labored within the barbed-wire area, accomplishing building miracles under the keen eyes of U. S. Army officers. It was a real war effort into which each one threw his best with patriotic enthusiasm. One fellow caught red-handed taking notes was driven from the property, not by the guards, but by his fellow-workmen. The last that was seen of him he was speeding down the railroad tracks pursued by an irate crowd in which white laboratory aprons and muddy blue overalls vied with each other for the first place.

Inside of nine months a number of the units making intermediate products for T. N. A. had been built, equipped and were ready for the first test runs. With correlated forethought the earlier steps in the operation were

ready, roughly in their proper sequence, so that each in turn might be in smooth-running production when the material it produced was needed for the following process. In this way final production of finished T. N. A. was completed within eleven months and from the first batch came through at projected capacities.

Then, as the movie captions say, came the Armistice!

With dramatic suddenness this mighty effort stopped. The Army ordered all manufacturing operations shut down and the finished T. N. A. on hand delivered to the Picatinny Arsenal.

Drastic changes had to be made quickly in all Calco plans and operations. The best facilities for the laboratories and drafting rooms, the most experienced men, had all been devoted to the great Government project. Research upon Calco products and processes had been neglected and expansion at the East Works had been reduced to dire necessities, the installation of additional equipment for increased production at the aniline plant and the building of a new nitrobenzene unit. Some essential changes had been made among the outlying plants acquired from Neidich. The operation in Canada was shut down and the manufacture of salicylic acid moved bodily to Burlington, New Jersey. Methylene blue production was abandoned at Burlington and centered at Jersey City. But the chief effort of that year was the consolidation of a couple of small dye plants purchased in Newark, New Jersey, into a single unit and some hard work to perfect their processes, increase the yields, and improve their products which were nigrosine and a small line of direct colors.

Sulfaipyridine and sulfathiazole — two of the most sensational of the new chemotherapeutic agents — were both synthesized by independent, original research in these Calco research laboratories. Even now new members of this same family of drugs are being developed by Calco's research staff. In addition to pharmaceuticals, dyestuffs and other chemicals for the textile trade are constantly the subject of intensive research activity.

With the coming of peace the whole American dyestuff industry







ANT

slumped into a veritable Slough of Despond. Fear of the on-coming flood of foreign colors and medicinals paralyzed both research and manufacturing. Buyers, waiting to see what kind of a tariff Congress would provide to safeguard the new-born synthetic coal-tar industry in this country, held off buying; though most of the leaders among them, recognizing the vital importance of a self-contained chemical industry, pleaded eloquently and effectively in Washington for adequate protection. But in the meantime stagnation descended like a thick fog upon all dyestuff activity.

At this critical juncture the Calco management faced the necessity of making important decisions promptly. The present situation was chaotic; the future, unpredictable. Yet to drift cheerfully along was to court certain disaster.

The whole coal-tar chemical market was in a turmoil. Almost overnight and without warning an insatiable war demand became an overwhelming peace surplus. As at the T. N. A. plant at Bound Brook, so all over the country, Government work was cut off. Contracts were cancelled right and left. Prices of crudes and intermediates tumbled—toluol from \$1.50 to 25 cents; phenol from 43 cents to 11 cents. What was worse the Government held surplus stock of many coal-tar materials far in excess of the country's normal annual consumption of them. It was commonly reported, for example, that there was sufficient benzol in hand to last five years and phenol enough to meet all demands till 1927. All this was disconcerting to a degree, but at least there was every assurance that the synthetic organic chemical industry in the United States would not be handicapped by any dearth of coal-tar raw materials and that prices would be reasonable.

Great progress had been made in dye-making. In 1914 seven American manufacturers produced 6,619,729 pounds of coal-tar colors, valued at \$2,470,096.00, supplying roughly a tenth of our dye requirements.

But nine-tenths of this domestic output had been prepared from imported intermediates.

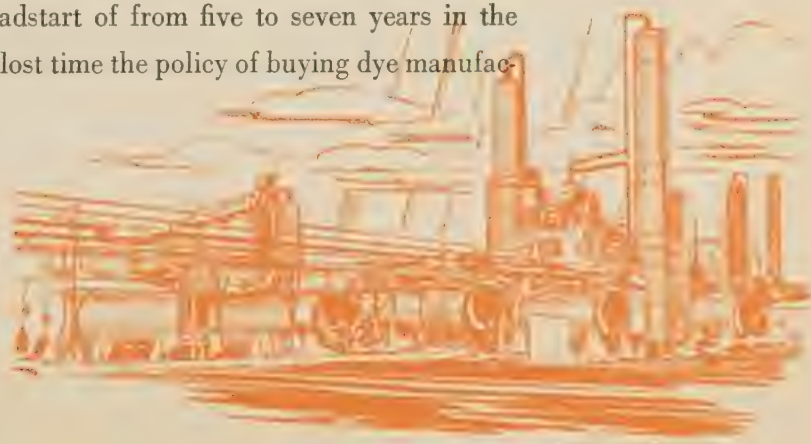
In 1920 over a hundred American plants turned out 88,263,776 pounds of dyes, valued at \$95,613,749.00. Every pound had been made out of American intermediates. Big gaps had still to be filled in the range of all needed colors, nevertheless the total poundage was in excess of our requirements. Already we were exporting large quantities of sulfur black and indigo to the Orient.

In five years, the challenge of the dye famine of 1915 had been met. But what would the next decade bring forth?

Convinced by their own experience of the fundamental importance of intermediates in coal-tar chemical manufacturing, the Calco management decided to specialize in this group of products. All the little dyestuff plants that had sprung up during the war could not possibly survive the bitter competitive battle that loomed ahead. Those that did so, however, must have adequate supplies of the best possible intermediates at the lowest possible cost. If a single company made the more important of these necessary products for all, higher quality and lower price would be achieved, to say nothing of the savings from the elimination of duplicated effort and investment.

This proposal was sound and logical. It failed; first, because the number of dye-making companies dwindled rapidly; and second, because the larger dye manufacturers felt that they must each be self-sufficient in the matter of their own intermediates.

When it became evident that the other companies would not support such a program Calco, in order to provide an outlet for its own intermediates, was forced to expand its activities into finished colors. In the meanwhile its competitors had a headstart of from five to seven years in the dyestuffs field. To make up this lost time the policy of buying dye manufac-



*L*EATHER'S usefulness lies in its strength, its flexibility, its toughness and its porosity. In recent years to these there have been added new qualities of beauty in finish and color. With each of these forward steps in the art of the tanner Calco has been co-operating with new special types of dyes suited, for example, to the requirements of tough chrome-tanned cowhide and supple garment-suede sheepskin. Today the leather colorist is able to comply with the changing dictates of fashion for brightly colored leathers because he has available appropriate, easily applied, crock-proof, light-proof dyes.



turing plants that were producing good lines of colors was adopted, and during the five years between 1924 and 1929 a number of such businesses were acquired and consolidated with the operations at Bound Brook.

The slump that followed the signing of the Armistice was followed by a short-lived boom that collapsed in the fall of 1920. We forget today the severity of that early post-war depression, but for every branch of the chemical industry it was a period of sharp contraction and rapidly falling prices. By this painful process most of the war-time inflation was squeezed out of chemicals, and for the recently established synthetic organic industry this drastic deflation was but the introduction to a long period of readjustment. During the reconstruction era of the early twenties Calco's war-won experience repaid all the long, grinding hours; all the good, hard dollars; all the anxieties and disappointments that it had cost. Those were days of trial for the whole dyestuff industry in America. Only the companies that met the acid test of bitter competition survived.

During the War, the Government had taken over more than four thousand five hundred enemy-owned dye patents. These covered not only the latest, most improved types of colors, but also many key processes selected with deliberate skill to block the development of a synthetic organic chemical industry in this country.

If these patents had not been made available to American manufacturers, the

German Dye Cartel's stranglehold on dyes and medicinals could never have been broken. However, if the best products and the nuisance-value processes became the property of a few individuals, even in American hands these patents would be of little help in building up a rounded,

The simplest but at the same time the most important dyestuffs are those classed as "azo" colors. These are made in large batches and carefully blended to definite standards suited to the particular needs of the trades in which they are to be used. Azo colors are extensively used for dyeing wool, cotton, silk, rayon, paper and leather as well as for the manufacture of many color lakes and inks. Certain azos are also used as food colors.



domestic industry. To auction them off to the highest bidder—as the Alien Property Custodian did with enemy-owned factories—might merely transfer a dye monopoly from Germany to America.

The vision of the late Francis P. Garvan foresaw these dangers and found the means to give the entire American chemical industry full benefit of these patent rights. He proposed that a quasi-public corporation be formed to buy all available patents relative to chemicals and to license their use for a small, uniform fee to any *bona fide* American manufacturer. His proposals were executed in the formation of The Chemical Foundation, Inc. Half a million dollars of stock was subscribed by practically every worthwhile American chemical manufacturing firm and immediately placed in a voting trust. The German patents were purchased from the Alien Property Custodian for \$250,000.00. A similar sum provided working capital and a fund to prosecute vigorously any attempt to import products covered by these patents. Mr. Garvan became President of the Foundation, and so began the long term of his brave, generous, devoted service to the up-building of a self-contained, independent American chemical industry. His patriotic labors were of highest value to the nation, and they ended only upon his death in 1937.

With the yoke of these patent restrictions lifted, American dye makers forged rapidly ahead. Many of the small companies which Calco acquired were working under Foundation licenses; but again profiting by the war experience, each step in every process was scrupulously re-examined in the Calco laboratories.





JOHN and Mary Consumer usually think of synthetic dyes as being packed away in the black, sticky coal-tar, all ready to be extracted by some curious chemical magic. The dye buyer is better informed. He knows that from the tar which is sweated out of coal in the coke ovens come a few basic raw materials: naphthalene, the light oils (containing benzene, toluene, and xylene), the tar acids (phenol, the cresols, and xylenols), the tar bases, and others.

These so-called coal-tar crudes are the basic raw materials of any synthetic organic chemical plant. Some 25,000 tons of those materials are received each year at Bound Brook. They arrive in their crude state, and every ounce is purified by fractional distillation and other refining methods to a much finer quality than is normally bought and sold.

While these highly refined crudes are the foundation of Calco dyes, nevertheless many other basic raw materials are used in vast quantities. Each year some 15,000 tons of sulfur, 7,000 tons of ammonia, over 10,000 tons of common salt are bought and manufactured into sulfuric, nitric, and hydrochloric acids. In neutralizing acid reactions and as sources of the element sodium more than 11,000 tons of alkalies (caustic soda, soda ash, and soda bicarbonate) are used every twelvemonth. Metallic iron, some 12,000 tons of it, is consumed annually as a reducing agent. Of all these basic chemical materials the Bound Brook plant uses over 80,000 tons a year, costing over \$6,000,000.00.

A clever chemical engineer once jokingly said that the more air and water it employed, the better any chemical process was. By this measure the Calco processes must be exceedingly efficient. Air is a fundamental source of oxygen and nitrogen. Water is a useful medium in which to carry on chemical reactions and a source of the valuable chemical radical "OH."

Save for the costly apparatus in which it is captured and forced into

ODERN science has given us paper in many new finishes and in an amazing array of fine colors. Newsprint and book papers and the old, standard wrappings have been joined by a host of so-called fancy papers—crepes and colored krafts, wax and parchment finishes, embossed and highly coated papers, each making unsuspected new demands upon paper colors. Calco's Heller & Merz unit is the oldest paper color organization in the United States, having commenced operations over seventy years ago just after the close of the Civil War. Today it is one of the principal suppliers of specialized colors for the paper trade.



chemical reactions air is free. But water is expensive to handle and treat, and the plant consumes nearly three and a half billion gallons during a year, more than enough to supply New Orleans, Cincinnati, Kansas City or any other city of half a million population.

As a matter of fact Calco uses six different and distinct kinds of water:

1—River water, pumped from the Raritan, which is the ordinary manufacturing water of most of the operations.

2—Well water, from the Company's own artesian wells, esteemed for its low temperature and its purity, very useful in cooling.

3—Filtered water, from the Company's filtration plant, required in a great number of processes.

4—Treated water, precipitated with alum and softened with trisodium phosphate, which must be handled in copper pipes, as it is contaminated in iron or brass.

5—Distilled water, for the laboratories and for all testing work, which is circulated to needed points in pure black tin pipes.

6—Potable water for the drinking and cooking supplies.

The correct water for the right chemical use is vastly more important than one would generally suspect. Indeed it has a more direct bearing on the quality of dyes than the Calco chemists even suspected before they learned by sad experience that the slightest trace of copper in water used in making certain direct dyes will have a definitely marked effect upon the shade of color produced.

That statement sounds simple enough. But it is far from a simple matter, having observed such slight differences in shade in the finished dyes, to trace back step by step, checking every variable factor in order to find the cause.

The coal-tar dyes come in family groups, as it were, descended from the various coal-tar crudes: benzene, toluene, xylene, phenol, naphthalene,



etc. Benzene is of chief importance. From it is prepared the intermediate aniline, parent of so many important groups of dyes that all coal-tar colors are often loosely called "aniline dyes." Historically, too, aniline is the progenitor of all synthetic colors. Back in 1856 it was from this material that an English college student, working during his Easter vacation to synthesize quinine, produced by chance the dyestuff "mauve" and had the genius to recognize the worth and meaning of his discovery.

Aniline from benzene is not a simple one-step operation. There are few such in coal-tar chemistry. First benzene is treated with a mixture of nitric and sulfuric acids. This process, called nitration, is one of the most common of the so-called "unit operations" of the coal-tar chemical industry. Applied to benzene, it produces nitro-benzene. Iron, water, and hydrochloric acid react together with nitro-benzene to produce aniline.

By sulfonation, that is by treatment with sulfuric acid, another very useful unit process in coal-tar synthesis, aniline becomes sulfanilic acid. By reacting aniline and aniline hydrochloride with methyl alcohol (wood alcohol) dimethyl-aniline is produced. From a score of aniline derivatives similar to these are produced dyes in practically all of the important dye-stuffs groups: azo, vat, sulfur, basic, even pigments, as well as a host of important medicinals: cinchophen, phenacetin, and the new wonder-drug sulfanilamide.

Aniline itself was one of the first so-called "rubber accelerators." Chemicals useful to this end not only speed up the vulcanization process but also lengthen the life of automobile tires by improving their wearing qualities. Aniline is the source of other important chemicals used for this purpose and to act as rubber anti-oxidants.

From the coal-tar crude benzene, through nitro-benzene which is the immediate parent of aniline, come also a number of its close chemical relatives (dinitro-benzene, para nitraniline, dinitro-aniline, meta phenylenedia-

mine) which are themselves starting points of many important processes. Benzene, in another chain of reactions, is changed by chlorine to chlorbenzene, which treated with nitric and sulfuric acids becomes para nitro-chlorbenzene, another important initial material in organic chemical synthesis.

Important as the benzene derivatives are, however, they are by no means the sole sources of coal-tar colors, flavors, and medicines. Second only to aniline in the Calco operations is beta naphthol, made by sulfonation of the coal-tar crude naphthalene. Toluene, by nitration, produces the high explosive trinitro-toluene (the T. N. T. of the World War) and the intermediates, ortho and para nitrotoluene. These intermediates are the starting point for the manufacture of dyes, rubber compounding chemicals, and perfume bases. In this family, after a long series of complex reactions, is produced vat pink, a member of a notable branch of the fast colors for cottons.

Plainly this manufacture of coal-tar dyes and medicinals is a complicated, highly technical, specialized business. The operations briefly outlined above are but the first three or four chemical steps towards the final products. Very few dyes are made in less than ten distinct chemical reactions; some require about twenty-five.

All the complex chemistry involved in these reactions must be continually under expert control. Every step in each process

has been checked and re-checked to make certain that quantities, apparatus, time, temperature, and pressures are each right and all correctly correlated. Moreover, each unit process must fit perfectly the quantities and the timing of the steps that proceed and follow it. Chemists in the laboratories and chemical engineers in the pilot plants are continually studying

In these laboratories, dyes are tested under conditions as near as possible to those under which they are to be used. Actual dyeings are made on all types of fibres. These are then tested for degrees of fastness under the direction of experts who have been trained for years in the practical application of dye-stuffs for all purposes.





ORGANIC color lakes are insoluble salts of certain dyestuffs and their use in printing inks, paints, lacquers, etc. constitutes an art in itself. The increased use of synthetic vehicles and finishes has broadened the field of application of this entire group of products.



all these factors and experimenting with slight variations in standard procedure to discover, if possible, a better or quicker way to make a purer product at less cost.

Competition in the American dye industry has brought dye consumers substantial benefits. In the dim distant pre-war era the first rule of conduct for salesmen towards buyers was: "Sell 'em and tell 'em nothing." Dyes were accordingly marketed under trick names that revealed little as to their composition or strength. The maximum in service to the customer was "matching shades" which meant selling him a package of color under his own special number (which told nothing, but was convenient for re-ordering) with directions for its application. This was all that a thoroughly cartelized competition required. There was no "keeping up with the Jones' " in either sales or service, in quality or price.

Modern sales methods are quite different. Instruct the consumer in all the finer points of quality and strength. Assist him in his application problems. Sell him on the basis of obtaining the best, most economical color, be it in a skein of rayon, a bolt of worsted, a gallon of paint, a pair of sport shoes, a ream of paper, or some bit of novelty jewelry in plastics.

Competition has forced a constant improvement in processes and in products. American dye users have been educated to expect qualities of strength and purity far, far exceeding the old pre-war specifications.

Between the upper and the nether millstones of quality and price, competitive pressure has forced the American dye industry to constant research for the direct benefit of the consumer. Calco's control over its basic raw materials is an initial advantage. Learning by doing was a thorough teacher. To achieve high quality dyes, the original methods of analysis Calco was forced so painstakingly to work out were of paramount importance, while in low costs the determining factor is most apt to be the correct time cycle.



The American production point-of-view is quite typical. It is bold—even venturesome—in the matter of quantities. Big batches in enormous apparatus — quantities unbelievable a few years ago — become standard practice.

Backed by the willingness constantly to overhaul processes and the resources necessary to scrap courageously operations and apparatus, this realistic approach has whittled down the weighted average price of all American-made dyes from \$1.26 a pound in 1917 to 55 cents in 1937. Considering the number of pounds sold, the U. S. Tariff Commission has estimated that year after year, for a number of years, the steady lowering of dye prices meant a saving of about \$6,000,000.00 annually to the dye-using industries. A substantial contribution that, and tangible evidence of how quickly competition has forced the American dye industry to pass along technological improvements to consumers.

Competition in quality has inevitably brought colors of higher concentration and greater purity to the market. For example, the old pre-war standard for aniline promised that 95 per cent of this intermediate would boil within a range of three degrees. Today Calco specifications guarantee that 95 per cent of the material will distill over within the narrow limits of .8 degree of 184° C. The tinctorial strength of practically every color as commonly sold in this country is higher—sometimes unbelievably higher—than was offered to American consumers in 1915. American dye users have learned that the true cost of a dye depends quite as much upon its concentration as upon its price per pound; and they have discovered in addition that purer, stronger colors mean not only greater convenience and economy in application, but also more uniform and satisfactory results.

Customers' problems are the subject of constant research in the Calco Application Laboratory. Here is at once a technical intelligence department and a bureau of standards, the connecting link between research,

manufacturing, and sales. Its primary purpose is to see to it that every customer gets the dyes best suited to his needs and complete, practical information enabling him to apply these dyes so as to get the best results.

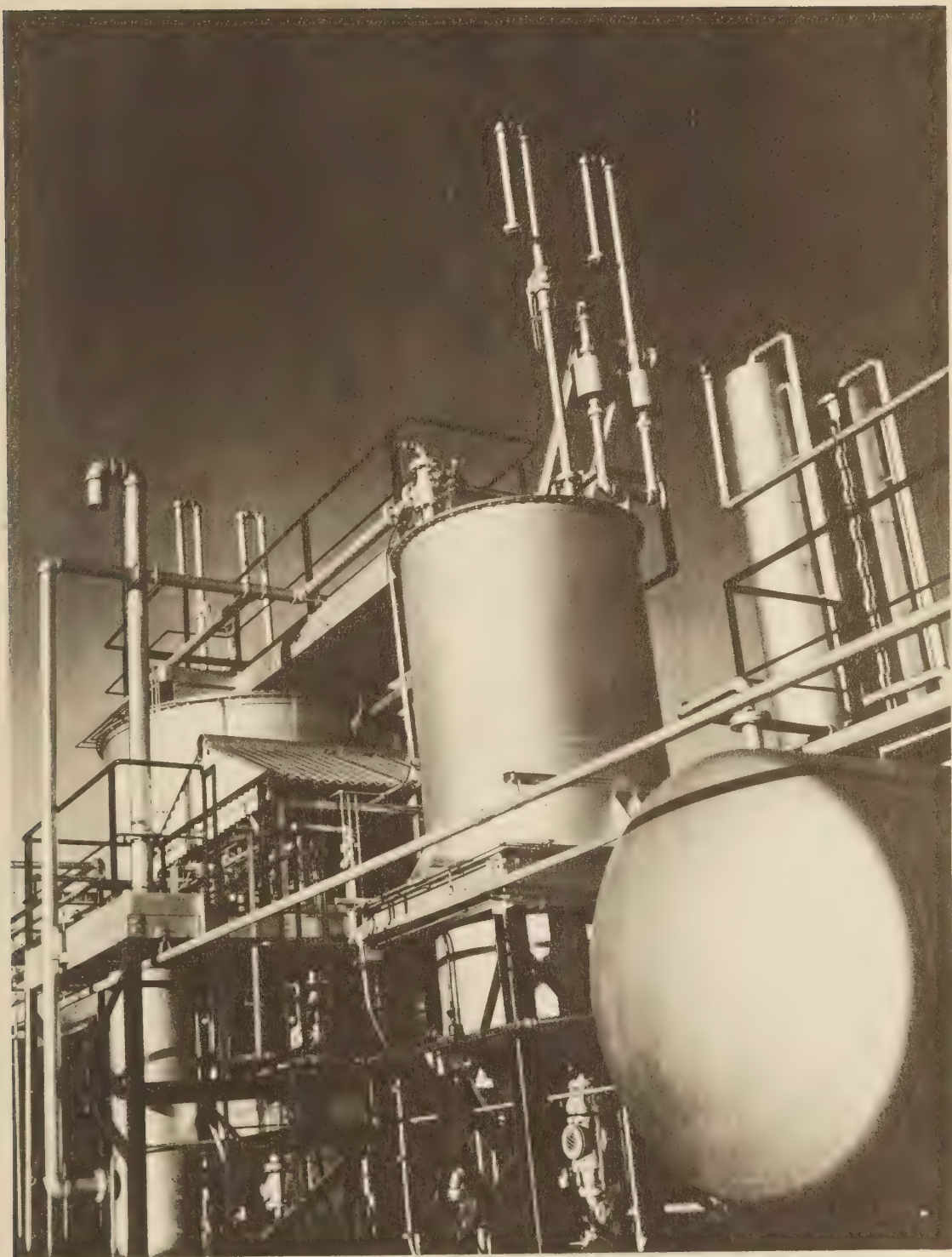
The Application Laboratory has constantly in hand three big jobs:

First, it examines critically all new dyes developed in the Research Department to appraise their commercial possibilities. No dyes of outstanding value must be overlooked. No foolish and expensive duplication of coloring materials can be tolerated. If a new color shows a worthwhile improvement over existing types, its uses are tested to establish standard practices of application. All this work requires not only experience and discrimination, but calls also for a rare combination of meticulous care and smart resourcefulness in testing. Mistakes made in this department can be very costly.

The second important task of the Application Laboratory is that which its name directly implies. The last word on the best way to apply any group of colors to any kind of materials has not yet been spoken. Likely it never will be. Both the methods and the materials are changing too rapidly. New synthetic fibres, new plastics, new wetting agents, new solvents, new sizes, new crease-resisting agents, new lubricants, new this and new that, shoulder their way into every color-using field almost daily. Any one of these may quite upset established dyeing procedure. Therefore, all must be checked.

When Sulfapyridine was developed, there was a world shortage of pure Pyridine for the manufacture of this product. Illustrative of Calco's policy of producing its basic materials is the Pyridine plant shown on the opposite page. In this plant Pyridine is separated from tar bases. It is then converted through a number of chemical processes into one of the most spectacular medicines of the last century.

To make confusion worse confounded, all these distinct factors in a dyeing problem may be mixed up in scores of different combinations. Indeed our modern textile fabrics are in themselves first-class dyeing puzzles, for they are mixtures of various natural and synthetic fibres, all with differ-



EW materials always develop their own new technique, and color in plastics is an ultra-modern, highly specialized branch of coal-tar dye chemistry. Processed under great pressure and at high temperatures; often chemically reactive; used for diverse purposes under diverse conditions, the plastics forced the discovery or development of new types of stable dyes. Blacks peculiarly suited for electrical instruments, for phonograph records, for radio panels, for non-odorous use in refrigerators, are but samples of these unusual and rigid demands of use, while pink for denture plates and fluorescent dyes that appear colored when exposed to ultra-violet radiations, suggest what a range of unusual color needs have been created.



ent dye affinities. Modern paints and lacquers hold similar complexities, formulas with so many ingredients that they resemble a recipe for an old fashioned plum pudding.

“Shade matching,” the name of the old fashioned sales service, is but the first step in the third important function of the Application Laboratory. This involves not merely selecting and blending dyes to duplicate a given hue, but nowadays these dyes must meet specific requirements in fastness and working properties and cost.

Finally, this technical service department studies the peculiar problems of customers in all fields. Hence it has been organized in groups that specialize in textile printing, wool dyeing, silk and acetate dyeing, direct dyeing of rayon and cotton goods, sulfur dyeing, vat and naphthol dyeing, leather dyeing, coloring plastics and resins, lacquers, and linoleums, paper dyeing and paper coating, and the study of lakes and paint colors.

Coal-tar dyes are the chief, but they are not the sole, Calco products. Twenty-five years ago the first product was aniline. The first customer was a rubber manufacturer who bought this material for the production of an accelerator. The second product, beta naphthol, was also sold in the rubber field to produce an anti-oxidant. From that day to this the Company has borne an important part in the development of rubber compounding chemicals which have made one of Chemistry's most conspicuous contributions to the theory of abundance created by better goods at less cost.

The rubber tire that cost sixty-five dollars in 1922 and had a life of less than five thousand miles, today costs but twelve dollars and is good for twenty thousand miles. More miles for less dollars is an economic service to the nation akin to that cut of six million dollars a year for several years from the color bill of the American people. To this progress in rubber compounding, Calco brought pioneering leadership in the development of the secondary amines and in supplying quantities of high purity intermediates



for the production of many new chemicals used in the manufacture of rubber.

When the famous German submarine "Deutschland" came to America during the war with a cargo of dyes and drugs, among the medicinals was one known as atophan (cinchophen) largely used at that time as a rheumatic analgesic. But the supply brought over on the "Deutschland" could satisfy only a small fraction of the American market. However, in 1918, a young chemist, then unknown, but now famous, came to Bound Brook looking for a job. Asked what he could do, he replied he believed he knew how to synthesize cinchophen. He did so and Calco was the first manufacturer of this important drug in the United States. Shortly afterwards, the closely-allied neocinchophen was developed and both of these drugs met a very urgent need of the American medical profession.

Gradually other valuable synthetic organic medicinals were developed and a separate department was organized to produce fine chemicals sold in bulk to pharmaceutical manufacturers. Formerly ethical specialties were promoted to the medical profession and distributed through the regular channels of the drug trade and the filling of physicians' prescriptions. This required a separate and distinct research staff investigating therapeutic problems and maintaining contacts with medical schools, hospitals and clinics the world over.

Recently Calco pharmaceutical research has joined up with the scientific staff of the Lederle Laboratories—a fellow-affiliate in the American Cyanamid Company and this strong combination has already brought about some noteworthy accomplishments in the medical field. Calco's principal ethical specialties have been transferred to Lederle, the Calco pharmaceutical department now specializing in the production and distribution of bulk pharmaceuticals. To Calco's experience in organic synthesis, Lederle brought knowledge and technique in biological chemistry, important pharmacological work, experience in animal testing, and wide clinical contacts.

This combination of skills and knowledge fitted together well, particularly in the new field opening in the development of synthetic specifics for infectious diseases, sulfanilamide and its derivatives. No advance in medical science made in the past half century comes even close to the importance of these discoveries in chemotherapeutics in which the Calco-Lederle team have won and maintain a position of leadership.

Everyone remembers the wave of sorrow that crossed our land when the brilliant young son of President Calvin Coolidge died from an infection developed in a blistered heel. The best medical brains of the country could do nothing for him. But in 1936 when the country was again concerned at the serious illness of the son of President Roosevelt, with a serious streptococcic throat infection, the press soon recorded the marvelous cure made by the use of sulfanilamide. Calco was one of the first to offer American-made sulfanilamide in commercial quantities and today is one of the largest American producers of this tremendously useful drug and its derivatives. Extensive fundamental research is being carried on systematically in synthesizing and testing other derivatives of sulfanilamide. The sensational sulfapyridine was discovered and quite independently of others by the Calco-Lederle team. This is also true of sulfathiazole. The latter drug is effective against staphylococci as well as pneumococci which is combatted by sulfapyridine.

Sulfapyridine alone has dropped the death rate of pneumonia and shortened the course of the disease in many cases to a few hours. Literally thousands of Americans are alive today because this drug is available. For instance in March, 1939, 82 persons per 100,000 policyholders of one of our great insurance companies died of pneumonia. In March, 1940, this figure was reduced to 54.9. In addition, other products which give promise of being valuable chemotherapeutic agents for combatting infectious diseases have been and are being discovered by this Calco-Lederle team.



BACK in 1920, when the Calco management first adopted the policy of using their own intermediates for finished dyes, rubber chemicals, and pharmaceuticals, less than fifty items were made in the Bound Brook plant. By 1930, the Calco products exceeded four hundred. That decade was the period during which the whole American dye industry was tried and tested.

Throughout the early twenties business in most of the dye-consuming fields was not brisk. Competition was therefore extraordinarily keen. Many readjustments and consolidations were forced upon the industry. Yet in the face of these unsettling conditions the number of dyes made in this country increased rapidly. By 1926, when business improved, most of the big-tonnage colors of comparatively simple preparation were available from American makers. During these years Calco assimilated a number of smaller dye companies, fitted their processes and products into the production and sales departments, rounding out the development of a full line of colors made from their own intermediates.

In February, 1929, Calco itself became a member of the American Cyanamid Company group. On both sides this was an advantageous joining of forces. Cyanamid, originally a maker of nitrogen fertilizer chemicals, was also seeking diversification so that the addition of an organic chemical line dovetailed into their carefully planned program. Calco, on the other hand, had learned that in absorbing new lines of dyes, large expenditures for research were obligatory and, furthermore, that if the fruits of successful research were to be reaped, manufacturing facilities must be constantly expanded. Alliance with Cyanamid brought financial strength, and assurance of a steady supply of certain chemical raw materials made by Cyanamid.

The year 1930 saw a continuation of the program of acquiring smaller dyestuff manufacturing businesses, more quickly to add to the Calco line



OLOR, more color, brighter, clearer color —that is the insistent demand of the stylists and designers of our 1940's. From delicate artificial flowers to tough battleship linoleum, for candles and candy, shoe polishes and nail polishes, toys, wall paper, soap, rouge, colored foils and colored gasoline, artists' crayons and pastel chalks, crepe paper, and what not, the call is always for more color and better colors. Both the number and the variety of these dye applications have become infinite. Many of them are highly specialized. Some consume big tonnages of dyes. Others use in a year but a few pounds of highly concentrated dyes. For all, Calco has dyes meeting the specified requirements.



of products. The climax of this expedient program of expansion came that same year in the acquisition of the old firm of Heller and Merz, one of the real pioneers of the American dyestuff industry. Starting shortly after the close of the Civil War with the manufacture of ultramarine blue, the business grew and waxed strong. It added many dyes to its line, especially those used in paper, and had won a deserved reputation for knowledge and understanding of the peculiar problems of the paper makers in which they had become specialists.

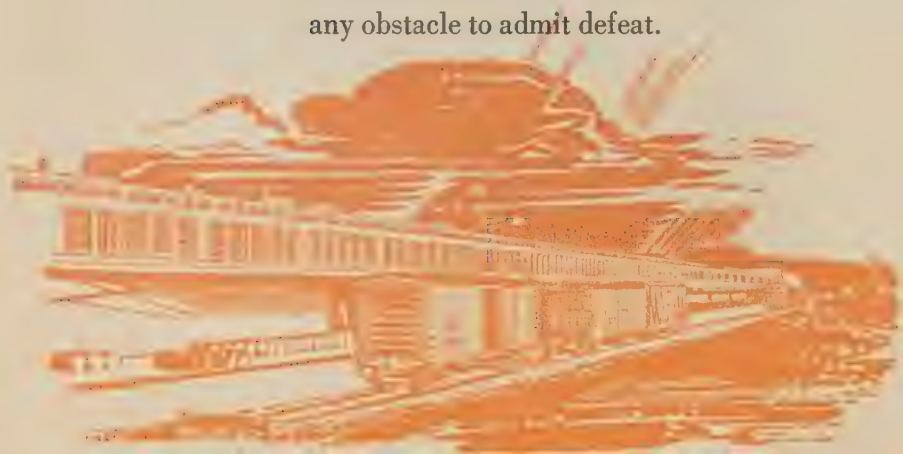
The result of this program, together with the company's own internal expansions, is that in 1940 more than five hundred distinct chemicals are on the list of Calco products. The company serves every dye-using industry with a practically full line of its needed colors.

And so, today, there is no chemical famine in this country.

No longer is the American dye user dependent upon foreign sources of supply. No European war can shove up the price of coal-tar intermediates to fantastic figures. Our physicians and hospitals are not now hampered in their merciful work by a shortage of any essential coal-tar medicine.

America today has a well-rounded, synthetic coal-tar industry, so that her plans for national defense can not now fall down for lack of war gases or high power explosives. Her chemical arsenal is now complete, equipped and manned, for any demand of peace or war.

Francis P. Garvan once said that our self-contained chemical industry was the only worthwhile thing that the United States won from the World War. That is true. But it was won, not as a gift, not as an indemnity; but as a reward for industrial courage of high order. It was won by the fine technical skill, and by the perseverance that in office, in laboratory, and in plant simply refused to knuckle under to any discouragement, or in the face of any obstacle to admit defeat.





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